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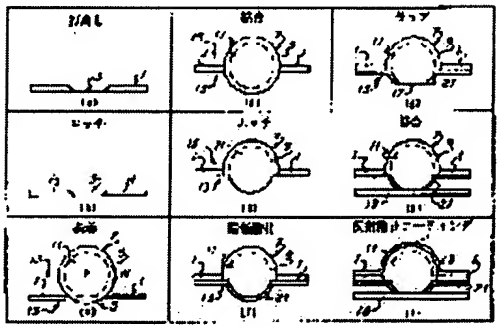
(54) FORMATION OF SOLAR ARRAY

(57)Abstract:
PURPOSE: To economically manufacture a solar array.
CONSTITUTION: A semiconductor grain 7, having a 1st conductive epidermal part 9 and a 2nd conductive inner part 11, is arranged on an aperture 5 of an aluminum foil 1, so as to be projected from both the sides of a foil 1, and the epidermal part 9 on one side is removed to form an insulating layer 21. Then a part of the inner part 11 and the insulating layer 21 formed on the part are removed, and a 2nd aluminum foil 19 is connected to the removed region 17. The planar region 17 provides a fine ohmic contact with the 2nd aluminum foil 19 as a conductive part.



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CLAIMS

[Claim(s)]
[Claim 1] In the approach (a) of forming a solar array The 1st aluminum foil is prepared. (b) Opening is formed in the predetermined location of said 1st aluminum foil (c). The epidermis subordinate the semi-conductor particle of the 2nd electric conduction form in the 1st electric conduction form to each of said opening [the epidermis section] It arranges so that this semi-conductor particle may project from the both sides of said 1st aluminum foil. (d) Said 1st electric conduction form epidermis section at one side of said 1st aluminum foil is removed. (e) An insulating layer is formed on said semi-conductor granular structure from which said 1st electric conduction form epidermis section was removed by said one side of said 1st aluminum foil, and the list. (f) The wrap aforementioned insulating layer is removed for it in said a part of semi-conductor granular structure where said 1st electric conduction form epidermis section was removed, and a list (g). How to form the solar array containing the step which combines the 2nd aluminium foil in the field to which said a part of semi-conductor granular structure was removed.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the approach of forming the solar battery (solar cell) generated from the ball of the silicon arranged in a metallic foil matrix when it exposes.
[0002]
[Description of the Prior Art] The equipment which therefore generates energy to change sunrays into the useful energy of other forms is known well, and since it is the profitability in which the suns are the main energy sources, such equipments are developed continuously and improved. Such one equipment is indicated by U.S. Pat. No. 4,021,323, and the solar array which embedded and prepared in the matrix the particle of the silicon of the P type which has the N type epidermis section at that one side, or the N type silicon which has the P type epidermis section in that one side at the solar array which consisted of transparent matrices like glass or plastics is indicated by this United States patent. This configuration is changeable although it is desirable that it is the P type in which a half particle has the N type epidermis section generally, and is the N type in which the remainder has the P type epidermis section. On the background of a matrix, the projecting particle interconnects by the suitable electric conduction metallizing part. The epidermis section of a silicon particle is ****** from a before [a matrix] side. the electrolyte with which such arrays contact a before [a matrix] side -- it is preferably immersed in a hydrobromic acid (HBr). The potential difference is set up between them under the sunlight electrolyzed into the bromine which remains dissolving HBr with the foaming hydrogen gas for the potential difference between the silicon particles of a different conductivity type in contact with an electrolyte. This is common knowledge, although hydrogen gas is collected, for example, being considered as energy sources, such as a fuel cell.
[0003] In the solar array of such formats, a silicon particle participates independently of electrolysis. Consequently, the rate at which a resultant is generated by the array is seldom influenced, even if the P-N junction of some particle connects too hastily or a shunt is carried out.
[0004] Although it is the same as that of the class described above, another equipment which generates useful energy from sunrays is constituted without electrolyzing so that power may be generated. Such one equipment is indicated by U.S. Pat. No. 2,904,613. Although other configurations are also possible, a helpful example prepares the particle of the N type silicon which has the P type epidermis section in a transparence matrix like glass or plastics, and is constituted. The core of the N type of a particle interconnects by the projection and the suitable electric conduction metallizing part from the background of a matrix. The P type epidermis section interconnects with the ingredient of translucency by conductivity like the tin oxide on a projection and a thin metal grid from a before [a matrix] side. Under sunlight, the potential difference can be set up between the interconnect sections after this array and by the side of before, it can be connected suitably, and electric power can be directly supplied to external electric load.
[0005] Amelioration of this technique is indicated by the United States patent application No. 562,782. Amelioration of invention described above is indicated by this application.
[0006]
[Problem(s) to be Solved by the Invention] However, in the actual condition, according to the conventional approach described above, the cost which manufactures a solar cell does not not much have profitability, and this conventional method has not stored the big success economically until now. Therefore, in order to supply the solar cell which may be realized economically, it is conditions absolutely that such arrays can be manufactured comparatively at an expensive price and economically.
[0007]
[Means for Solving the Problem] In this invention, the conventional problems described above are reduced

substantially and the approach of forming the solar array which can manufacture a solar array economically is offered compared with the conventional technique quoted before.

[0008] If it says simply, in this invention, the 1st sheet of the flexible aluminium foil of the normal mode which is considered to have a natural aluminum oxide in that front face will be prepared, and a solar array will be formed. A foil is hammered out in the location which should arrange the ball of silicon, and a metal matrix is formed. Then, it etches in order to remove the thin area which cleaned the foil and hammered out except for the organic substance and to make opening there, and the location for inserting a silicon ball is made. A mat side (mattesurface) is made in a foil using another etching process. While a foil forms housing to the ball which should be applied to it, the before side contact is formed. It intercepts that carry out the deposit of the ball of the silicon which has the N type epidermis section on P type to the side front of a foil, prepare a vacuum chuck in the background of a foil, absorb to opening which formed the ball beforehand, put in to the middle into it, and air passes this opening. Since a superfluous number of balls are used compared with the number of openings at first, the ball with which openings were buried [no] with the ball and used after that eventually is removed when brushing etc. carries out the rear face of a foil.

[0009] Next, the ball of silicon is combined with aluminium foil by using an impact press. This press pushes in a ball into opening, and the equator of a ball is up and it is made to come to the side front (side which turned to the sun or the light) of a foil from a foil. By pushing in a ball into opening by the strong force at this appearance, the aluminum of the front face in contact with the ball of silicon splits, and fresh aluminum is exposed in that location. A surface aluminum oxide is also cut off by shearing produced by migration of the ball of the silicon to aluminum, and such exposed fresh aluminum is obtained by it. This operation removes the real superior anterior portion of silicon oxide from the part of the ball in contact with aluminium foil, especially the exposed aluminum. This operation is performed by setting aluminum to the temperature of about 500 degrees C thru/or less than 577 degrees C within the limits, at this time, although aluminum is a solid-state, it is [become] easy to deform, and silicon is still the rigid body at this temperature to this. (If the persistence time of impact is brief enough, it can also be made temperature higher than 577 degrees C.) Fresh aluminum corrodes diacid-ized silicon and it is substantially removed in the location which added impact in the case of impact. Thus, association between silicon and aluminum is obtained and the aluminum contact over the N type epidermis layer of silicon is formed. Then, he leaves it to cooling the array which consists of a foil and a ball to ambient temperature, and a foil hardening again.

[0010] Next, the background of the foil which the ball has exposed is slept together and the N type epidermis section which is there is removed. This is because aluminium foil acts as a mask to silicon etchant. Since, as for the foil itself, natural oxide coating very thin on it is usually formed, there is no reactivity not much. Next, about 1/of arrays is put in for 2 minutes in a sulfuric-acid bus (bath) (about 10% H2 SO4), an array is anodized, and oxide coating is prepared on aluminum. Next, in order to seal aluminum and to anodize silicon, it is 0.5%H3 PO4. Another anodization bus to include is used. Thus, about 10-micrometer aluminum 2O3 And 0.1-micrometer SiO2 It grows up. Next, the lap of the rear face of a ball is carried out, and the field for making it contact is established. Surface roughening of this field is carried out by the lap process, and an ohmic contact good for this reason comes to be formed of it. Next, after applying to the field which carried out the lap of the 2nd foil of thin aluminum and preheating to the temperature of 500 degrees C thru/or less than 577 degrees C within the limits, an impact press is carried out and the contact over this field is formed in the field which carried out the lap of the foil.

[0011] When forming an array in the reel form example, before combining the 2nd foil with a ball, the epidermis section is arranged between two foils in the location between adjoining arrays. It and association are not carried out, although the foil of an upside and the bottom is pushed against the epidermis section in this example in case the 2nd foil is combined with a ball. Then, a foil extension [as opposed to each foil for a foil] is suitably prepared by the both sides of a marking-off and an array on the epidermis section on both sides of an array. Next, this foil extension of each other can be connected to a series circuit, and an amplification circuit can be formed.

[0012] It can have a marking-off and the 2nd foil part to which it dissociates mutually, it bevels and only one side of a rectangular array is extended outward in the form of a contact for an array with the epidermis section which was described above. Such contacts are connected to the 1st foil part of other arrays in the geometric form of arbitration, and a module with an input and an output is made.

[0013] Consequently, the solar cell which enlarged magnitude of the front face which can be used in order to arrange the main parts of the ball of each silicon at a before [an array] side and to receive sunrays is obtained. Furthermore, though natural, this array is flexibility, has a light reflex machine in aluminium foil, and is offered using the ingredient and down stream processing which are not comparatively expensive as for a fraction.

[0014]

[Example] Down stream processing using the description of this invention for forming a solar array according to this invention is shown to Figs. 1 and 2 by schematic drawing. At first, the aluminium foil 1 with a thickness of about 2 mils is prepared. This foil is flexibility, and since it has exposed ordinarily to an environment, it is common to have a very thin natural oxide layer in that front face. Although the following explanation is related with one member of a solar array, please permit the whole array for there to be many array members so that the conventional technique explained above shows.

[0015] As aluminium foil 1 is first shown in (a), it is arrangement of six periodic square shapes, for example, it hammers out by 16 mils of centers to center, and it hammers out and the section 3 is made into a diameter [a little] smaller than the diameter of sphere to which thickness became thin and which it is going to arrange in it. The printing section may be the geometric form of circular or others like six square shapes. In printing of a polygon, the line which crosses a polygon through a core is made smaller than the diameter of sphere applied to this. Next, a foil is washed, the organic substance is removed and it sleeps together using the sodium hydroxide or potassium heated as shown in (b) after that, and while removing the field which made the printing section 3 among foils, opening 5 is formed in the location. During etching, since it is much more thinner than other parts of a foil, while being removed ahead of other parts of a foil, also in order to make cold working by printing performed there, as for the printing field 3, sleeping together is still quicker. This is called an aluminum matrix.

[0016] At this point, they are 25%HF and 60%HNO3 by optional selection. And by etching using 50% solution of the etchant which is 15% glacial acetic acid, a certain ground can be given to a foil and the matrix side which suppresses back reflection to the minimum can be made.

[0017] As shown in (c), the deposit of the ball 7 of two or more silicon with the N type epidermis section 9 and the interior 11 of P type is carried out to the matrix upside 15 on a foil 1, a vacuum is added to the background 13 of a foil using a vacuum chuck, and a ball 7 is drawn into opening 5. First, since the superfluous ball 7 is used compared with the number of openings 5, all openings are buried with a ball 7 and the superfluous ball 7 is removed from a foil 1 upside by the brush cliff etc. after that on the background of a foil. Although it is desirable that a diameter is 14.5 mils here as for ******, the cross-section diameter of opening 5 is smaller than 14.5 mils to the appearance described above and a vacuum is applied to a foil on the background of a foil at it, the reason is explained later.

[0018] Then, as shown in (d), a ball 7 is combined in the opening 5 of aluminium foil 1 by heating a foil and subsequently using an impact press. At this time, a ball 7 is quickly embedded into opening 5, a shearing operation is produced within opening, the aluminum oxide which has it in the inner surface of the foil of the place of opening is shaved off, and a fresh aluminum element is exposed. For this reason, like, when [at which it stated above] a ball 7 is embedded into opening 5, aluminum is heated by the temperature of 530 degrees C, it is reactivity, and a mechanical property has viscosity a little and aluminum deforms it easily. Therefore, the aluminum of an element can react with the very thin natural silicon oxide layer on a ball, it can be removed, it can combine with the silicon element which has aluminum of a foil 1 in the N type layer 9 of a ball at this time for this reason directly, and the contact over it can be formed.

[0019] A ball 7 is arranged in opening 5 at the appearance which has the equator of a ball in the upper part or its upper part 15 from aluminium foil 1. Such arrangement is attained by using the pressure pad with which aluminium foil 1 has been arranged up and down. The pressure pad is formed with aluminium foil with a thickness of about 8 mils covered with a release agent like the powder of boron nitride which acts as a cushion, and for this reason, a ball is not damaged in case the hammer of an impact press adds impact. Furthermore, a pressure pad absorbs the impact of a hammer. It is thick and is made for the equator of a ball to shift from a foil to the appearance described above rather than the pressure pad of the bottom which is in 13 side of a foil 1 with the pressure pad of the upside in 15 side of a foil 1. It turned out to 2cm square of array that it acts with sufficient impact energy ****** of about 48 feet pounds. For this reason, it is as having stated above that aluminum is directly combined with silicon at this time.

[0020] As the part which is in a this side the field 13 on the backside [a foil 1] and among balls 7 is shown in (e) after this, it sleeps together using etchant, and the part which is on an array rear face among the N type layers 9 is removed, and a P type field is exposed. The aluminium foil 1 which has natural oxide on it acts as a mask to this etchant, and it enables it to remove only the part of the layer 9 in backside [an array] 13. Then, as an array is washed by deionized water and it is shown in (f) below except for etchant, they are for [about 1/] 2 minutes and 10%H2 SO4 at about 20 volts. An array is anodized within a solution and passivation of the silicon and aluminium foil 1 which were exposed is carried out. Next, it is 0.5%H3 PO4 during about 1-/2 minutes at about 20 volts. An array is anodized within a solution. The time amount which anodization takes is a function in case the current of a bus becomes zero and is closed, and it turned out that this is about 1 / 2 minutes. It is important to use phosphoric acid, this closed the hole in an aluminum oxide, and it turned out that about 1,000A oxide layer 21 is made on the silicon front face which

slept together before.
[0021] Next, after being formed in the case of anodic oxidation, the lap of the ball 7 of the anodized array is carried out by ablating mechanically by the approach of common knowledge of side 21. Both diacidized silicon 21 and some silicon are removed by this wrapping, the rear face 17 of a ball 7 becomes flat, as shown in 17, a split face is acquired, and for this reason, an ohmic contact can be formed on it. Next, as about 1 / thin foil 19 of 2-mil aluminum is shown in (h), it arranges on the rear face 17 of each ball 7, and it is made to come on the flat field 17 as for which it carried out the lap. Although this aluminum is preferably heated to the temperature within the limits of the temperature of 530 degrees C or about 500 thru/or 577 degrees C, there are conditions which were described above. The heated foil 19 is stuck to a ball 7 by pressure with an impact press after this, and the bond part between the aluminum exposed by this impact and the silicon exposed to the wrapping list on the rear face of a ball 7 for the impact by the aluminum element is formed. By joining together the same with having described (d) above, the contact 19 of the foil to the silicon field 11 is formed. For anodic oxidation of aluminium foil 1, a thick aluminum oxide is on the front face of this foil, and the short circuit between a foil 1 and a foil 19 is prevented. (As shown in (i), standard antireflection coating can be applied on the field by the side of before an array, and the absorption of light of silicon can be improved.) Therefore, the ingredient used for the processing list used by the array, being flexibility be comparatively expensive, and there be few numbers, and they be making [it expose to the sunrays in which most balls of silicon carry out incidence, and], and it will be understood that the solar array be offered.
[0022] In actual down stream processing, an array which was described above is not as a separate array, and preparing in the example of a reel form is common. Then, an array is formed in a module [as / whose dimension is 1mx2m], and is examined with such designs. As for each array formed as stated until now, it is common that each side is about 10cm.
[0023] In order to make a solar array which was described above in a reel form and to form a module, a procedure as shown in drawing 3 thru/or drawing 6 is followed. If drawing 3 is explained first, the array interworking unit is shown to this drawing by one dimension. In drawing 3 (a), one array 30 which fixed the ball 31 to the contact foil member 33 by the side of before is shown, and the backside foil member 35 is not attached in the ball yet. SIMM 37 is inserted between arrays 30 as clearly shown in drawing 4 (a). Although the foil 33 by the side of before has a dimension smaller than the foil 35 on the backside so that drawing 4 (a) may show, the reason becomes clear later.
[0024] Next, when drawing 3 (b) is seen, it turns out that the foil 35 on the backside touches a ball 31 and SIMM 37 at this time. The upper foil 33 also touches SIMM. This is the process (h) of drawing 1 , and when combining the foil 35 on the backside with a ball 31 as a part of this down stream processing, it is attained. Foils 33 and 35 are not pasted up on SIMM 37, but it is only in contact with it. Then, after separating a marking-off and an array for the foil of each other next in the location of V typeface notation of drawing 3 (b) on SIMM and demounting SIMM, equipment as shown in drawing 3 (c) and drawing 4 (c) is made. Next, it bevels, as an array as shown in drawing 3 (c) and drawing 4 (b) is shown in drawing 4 (c), and four lugs which are some foils 35 on the backside are made. These lugs are each side of the rectangular head of an array, and are described as A, B, C, and D. Next, as shown in drawing 3 (d) and drawing 4 (d), Lugs B, C, and D are turned up under an array, and as shown in drawing 3 (e) after that, this array is fixed to a next array by ultrasonic association etc. by combining Lug A with one of the lugs B and C of an array, or D after this.
[0025] An interconnect process can be performed as the equipment of a three-dimensional display of drawing 5 shows. With this equipment, one array in which Lug A is carrying out extension is positioned so that this lug A may contact one of the lugs B and C of another array, or D. This procedure is continued at the path of a straight line or others, and a perfect module is made. The completed module is shown in drawing 6 , it is fixed to Lugs B and C or D of an array 30 which Lug A adjoins, and the path arranged before and after forming the series circuit of 60 arrays is made. Furthermore, the lug used as the input 41 and output 43 to a module is prepared.
[0026] If drawing 2 is explained, and a module will be examined and it will succeed in a trial after forming the module of drawing 6 , a module will progress to the process attached in the charge of supporting material etc., a lug will be ultrasonically combined by joint appearance after that, the encapsulation of the module will be carried out after that, and suitable **** to an environment will be given. Next, the module which carried out encapsulation is examined standardly and it will be in the condition that the module which can operate can be used.
[0027] Although the desirable example of specification [this invention] was explained, to this contractor, I will consider various modification. Therefore, a claim is seen from the conventional technique and should be interpreted as widely as possible so that such all modification may be ****(ed).

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the approach of forming the solar battery (solar cell) generated from the ball of the silicon arranged in a metallic foil matrix when it exposes.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The equipment which therefore generates energy to change sunrays into the useful energy of other forms is known well, and since it is the profitability in which the suns are the main energy sources, such equipments are developed continuously and improved. Such one equipment is indicated by U.S. Pat. No. 4,021,323, and the solar array which embedded and prepared in the matrix the particle of the silicon of the P type which has the N type epidermis section at that one side, or the N type silicon which has the P type epidermis section in that one side at the solar array which consisted of transparent matrices like glass or plastics is indicated by this United States patent. This configuration is changeable although it is desirable that it is the P type in which a half particle has the N type epidermis section generally, and is the N type in which the remainder has the P type epidermis section. On the background of a matrix, the projecting particle interconnects by the suitable electric conduction metallizing part. The epidermis section of a silicon particle is ****** from a before [a matrix] side. the electrolyte with which such arrays contact a before [a matrix] side -- it is preferably immersed in a hydrobromic acid (HBr). The potential difference is set up between them under the sunlight electrolyzed into the bromine which remains dissolving HBr with the foaming hydrogen gas for the potential difference between the silicon particles of a different conductivity type in contact with an electrolyte. This is common knowledge, although hydrogen gas is collected, for example, being considered as energy sources, such as a fuel cell.

[0003] In the solar array of such formats, a silicon particle participates independently of electrolysis. Consequently, the rate at which a resultant is generated by the array is seldom influenced, even if the P-N junction of some particle connects too hastily or a shunt is carried out.

[0004] Although it is the same as that of the class described above, another equipment which generates useful energy from sunrays is constituted without electrolyzing so that power may be generated. Such one equipment is indicated by U.S. Pat. No. 2,904,613. Although other configurations are also possible, a helpful example prepares the particle of the N type silicon which has the P type epidermis section in a transparence matrix like glass or plastics, and is constituted. The core of the N type of a particle interconnects by the projection and the suitable electric conduction metallizing part from the background of a matrix. The P type epidermis section interconnects with the ingredient of translucency by conductivity like the tin oxide on a projection and a thin metal grid from a before [a matrix] side. Under sunlight, the potential difference can be set up between the interconnect sections after this array and by the side of before, it can be connected suitably, and electric power can be directly supplied to external electric load.

[0005] Amelioration of this technique is indicated by the United States patent application No. 562,782. Amelioration of invention described above is indicated by this application.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the actual condition, according to the conventional approach described above, the cost which manufactures a solar cell does not not much have profitability, and this conventional method has not stored the big success economically until now. Therefore, in order to supply the solar cell which may be realized economically, it is conditions absolutely that such arrays can be manufactured comparatively at an expensive price and economically.

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* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In this invention, the conventional problems described above are reduced substantially and the approach of forming the solar array which can manufacture a solar array economically is offered compared with the conventional technique quoted before.
[0008] If it says simply, in this invention, the 1st sheet of the flexible aluminium foil of the normal mode which is considered to have a natural aluminum oxide in that front face will be prepared, and a solar array will be formed. A foil is hammered out in the location which should arrange the ball of silicon, and a metal matrix is formed. Then, it etches in order to remove the thin area which cleaned the foil and hammered out except for the organic substance and to make opening there, and the location for inserting a silicon ball is made. A mat side (mattesurface) is made in a foil using another etching process. While a foil forms housing to the ball which should be applied to it, the before side contact is formed. It intercepts that carry out the deposit of the ball of the silicon which has the N type epidermis section on P type to the side front of a foil, prepare a vacuum chuck in the background of a foil, absorb to opening which formed the ball beforehand, put in to the middle into it, and air passes this opening. Since a superfluous number of balls are used compared with the number of openings at first, the ball with which openings were buried [no] with the ball and used after that eventually is removed when brushing etc. carries out the rear face of a foil.
[0009] Next, the ball of silicon is combined with aluminium foil by using an impact press. This press pushes in a ball into opening, and the equator of a ball is up and it is made to come to the side front (side which turned to the sun or the light) of a foil from a foil. By pushing in a ball into opening by the strong force at this appearance, the aluminum of the front face in contact with the ball of silicon splits, and fresh aluminum is exposed in that location. A surface aluminum oxide is also cut off by shearing produced by migration of the ball of the silicon to aluminum, and such exposed fresh aluminum is obtained by it. This operation removes the real superior anterior portion of silicon oxide from the part of the ball in contact with aluminium foil, especially the exposed aluminum. This operation is performed by setting aluminum to the temperature of about 500 degrees C thru/or less than 577 degrees C within the limits, at this time, although aluminum is a solid-state, it is [become] easy to deform, and silicon is still the rigid body at this temperature to this. (If the persistence time of impact is brief enough, it can also be made temperature higher than 577 degrees C.) Fresh aluminum corrodes diacid-ized silicon and it is substantially removed in the location which added impact in the case of impact. Thus, association between silicon and aluminum is obtained and the aluminum contact over the N type epidermis layer of silicon is formed. Then, he leaves it to cooling the array which consists of a foil and a ball to ambient temperature, and a foil hardening again.
[0010] Next, the background of the foil which the ball has exposed is slept together and the N type epidermis section which is there is removed. This is because aluminium foil acts as a mask to silicon etchant. Since, as for the foil itself, natural oxide coating very thin on it is usually formed, there is no reactivity not much. Next, about 1/of arrays is put in for 2 minutes in a sulfuric-acid bus (bath) (about 10% H2 SO4), an array is anodized, and oxide coating is prepared on aluminum. Next, in order to seal aluminum and to anodize silicon, it is 0.5%H3 PO4. Another anodization bus to include is used. Thus, about 10-micrometer aluminum 2O3 And 0.1-micrometer SiO2 It grows up. Next, the lap of the rear face of a ball is carried out, and the field for making it contact is established. Surface roughening of this field is carried out by the lap process, and an ohmic contact good for this reason comes to be formed of it. Next, after applying to the field which carried out the lap of the 2nd foil of thin aluminum and preheating to the temperature of 500 degrees C thru/or less than 577 degrees C within the limits, an impact press is carried out and the contact over this field is formed in the field which carried out the lap of the foil.
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association are not carried out, although the foil of an upside and the bottom is pushed against the epidermis section in this example in case the 2nd foil is combined with a ball. Then, a foil extension [as opposed to each foil for a foil] is suitably prepared by the both sides of a marking-off and an array on the epidermis section on both sides of an array. Next, this foil extension of each other can be connected to a series circuit, and an amplification circuit can be formed.

[0012] It can have a marking-off and the 2nd foil part to which it dissociates mutually, it bevels and only one side of a rectangular array is extended outward in the form of a contact for an array with the epidermis section which was described above. Such contacts are connected to the 1st foil part of other arrays in the geometric form of arbitration, and a module with an input and an output is made.

[0013] Consequently, the solar cell which enlarged magnitude of the front face which can be used in order to arrange the main parts of the ball of each silicon at a before [an array] side and to receive sunrays is obtained. Furthermore, though natural, this array is flexibility, has a light reflex machine in aluminium foil, and is offered using the ingredient and down stream processing which are not comparatively expensive as for a fraction.

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EXAMPLE

[Example] Down stream processing using the description of this invention for forming a solar array according to this invention is shown to Figs. 1 and 2 by schematic drawing. At first, the aluminium foil 1 with a thickness of about 2 mils is prepared. This foil is flexibility, and since it has exposed ordinarily to an environment, it is common to have a very thin natural oxide layer in that front face. Although the following explanation is related with one member of a solar array, please permit the whole array for there to be many array members so that the conventional technique explained above shows.
[0015] As aluminium foil 1 is first shown in (a), it is arrangement of six periodic square shapes, for example, it hammers out by 16 mils of centers to center, and it hammers out and the section 3 is made into a diameter [a little] smaller than the diameter of sphere to which thickness became thin and which it is going to arrange in it. The printing section may be the geometric form of circular or others like six square shapes. In printing of a polygon, the line which crosses a polygon through a core is made smaller than the diameter of sphere applied to this. Next, a foil is washed, the organic substance is removed and it sleeps together using the sodium hydroxide or potassium heated as shown in (b) after that, and while removing the field which made the printing section 3 among foils, opening 5 is formed in the location. During etching, since it is much more thinner than other parts of a foil, while being removed ahead of other parts of a foil, also in order to make cold working by printing performed there, as for the printing field 3, sleeping together is still quicker. This is called an aluminum matrix.
[0016] At this point, they are 25%HF and 60%HNO3 by optional selection. And by etching using 50% solution of the etchant which is 15% glacial acetic acid, a certain ground can be given to a foil and the matrix side which suppresses back reflection to the minimum can be made.
[0017] As shown in (c), the deposit of the ball 7 of two or more silicon with the N type epidermis section 9 and the interior 11 of P type is carried out to the matrix upside 15 on a foil 1, a vacuum is added to the background 13 of a foil using a vacuum chuck, and a ball 7 is drawn into opening 5. First, since the superfluous ball 7 is used compared with the number of openings 5, all openings are buried with a ball 7 and the superfluous ball 7 is removed from a foil 1 upside by the brush cliff etc. after that on the background of a foil. Although it is desirable that a diameter is 14.5 mils here as for ******, the cross-section diameter of opening 5 is smaller than 14.5 mils to the appearance described above and a vacuum is applied to a foil on the background of a foil at it, the reason is explained later.
[0018] Then, as shown in (d), a ball 7 is combined in the opening 5 of aluminium foil 1 by heating a foil and subsequently using an impact press. At this time, a ball 7 is quickly embedded into opening 5, a shearing operation is produced within opening, the aluminum oxide which has it in the inner surface of the foil of the place of opening is shaved off, and a fresh aluminum element is exposed. For this reason, like, when [at which it stated above] a ball 7 is embedded into opening 5, aluminum is heated by the temperature of 530 degrees C, it is reactivity, and a mechanical property has viscosity a little and aluminum deforms it easily. Therefore, the aluminum of an element can react with the very thin natural silicon oxide layer on a ball, it can be removed, it can combine with the silicon element which has aluminum of a foil 1 in the N type layer 9 of a ball at this time for this reason directly, and the contact over it can be formed.
[0019] A ball 7 is arranged in opening 5 at the appearance which has the equator of a ball in the upper part or its upper part 15 from aluminium foil 1. Such arrangement is attained by using the pressure pad with which aluminium foil 1 has been arranged up and down. The pressure pad is formed with aluminium foil with a thickness of about 8 mils covered with a release agent like the powder of boron nitride which acts as a cushion, and for this reason, a ball is not damaged in case the hammer of an impact press adds impact. Furthermore, a pressure pad absorbs the impact of a hammer. It is thick and is made for the equator of a ball to shift from a foil to the appearance described above rather than the pressure pad of the

bottom which is in 13 side of a foil 1 with the pressure pad of the upside in 15 side of a foil 1. It turned out to 2cm square of array that it acts with sufficient impact energy ****** of about 48 feet pounds. For this reason, it is as having stated above that aluminum is directly combined with silicon at this time.
[0020] As the part which is in a this side the field 13 on the backside [a foil 1] and among balls 7 is shown in (e) after this, it sleeps together using etchant, and the part which is on an array rear face among the N type layers 9 is removed, and a P type field is exposed. The aluminium foil 1 which has natural oxide on it acts as a mask to this etchant, and it enables it to remove only the part of the layer 9 in backside [an array] 13. Then, as an array is washed by deionized water and it is shown in (f) below except for etchant, they are for [about 1/] 2 minutes and 10%H2 SO4 at about 20 volts. An array is anodized within a solution and passivation of the silicon and aluminium foil 1 which were exposed is carried out. Next, it is 0.5%H3 PO4 during about 1-/2 minutes at about 20 volts. An array is anodized within a solution. The time amount which anodization takes is a function in case the current of a bus becomes zero and is closed, and it turned out that this is about 1 / 2 minutes. It is important to use phosphoric acid, this closed the hole in an aluminum oxide, and it turned out that about 1,000A oxide layer 21 is made on the silicon front face which slept together before.
[0021] Next, after being formed in the case of anodic oxidation, the lap of the ball 7 of the anodized array is carried out by ablating mechanically by the approach of common knowledge of side 21. Both diacid-ized silicon 21 and some silicon are removed by this wrapping, the rear face 17 of a ball 7 becomes flat, as shown in 17, a split face is acquired, and for this reason, an ohmic contact can be formed on it. Next, as about 1 / thin foil 19 of 2-mil aluminum is shown in (h), it arranges on the rear face 17 of each ball 7, and it is made to come on the flat field 17 as for which it carried out the lap. Although this aluminum is preferably heated to the temperature within the limits of the temperature of 530 degrees C or about 500 thru/or 577 degrees C, there are conditions which were described above. The heated foil 19 is stuck to a ball 7 by pressure with an impact press after this, and the bond part between the aluminum exposed by this impact and the silicon exposed to the wrapping list on the rear face of a ball 7 for the impact by the aluminum element is formed. By joining together the same with having described (d) above, the contact 19 of the foil to the silicon field 11 is formed. For anodic oxidation of aluminium foil 1, a thick aluminum oxide is on the front face of this foil, and the short circuit between a foil 1 and a foil 19 is prevented. (As shown in (i), standard antireflection coating can be applied on the field by the side of before an array, and the absorption of light of silicon can be improved.) Therefore, the ingredient used for the processing list used by the array, being flexibility be comparatively expensive, and there be few numbers, and they be making [it expose to the sunrays in which most balls of silicon carry out incidence, and], and it will be understood that the solar array be offered.
[0022] In actual down stream processing, an array which was described above is not as a separate array, and preparing in the example of a reel form is common. Then, an array is formed in a module [as / whose dimension is 1mx2m], and is examined with such designs. As for each array formed as stated until now, it is common that each side is about 10cm.
[0023] In order to make a solar array which was described above in a reel form and to form a module, a procedure as shown in drawing 3 thru/or drawing 6 is followed. If drawing 3 is explained first, the array interworking unit is shown to this drawing by one dimension. In drawing 3 (a), one array 30 which fixed the ball 31 to the contact foil member 33 by the side of before is shown, and the backside foil member 35 is not attached in the ball yet. SIMM 37 is inserted between arrays 30 as clearly shown in drawing 4 (a). Although the foil 33 by the side of before has a dimension smaller than the foil 35 on the backside so that drawing 4 (a) may show, the reason becomes clear later.
[0024] Next, when drawing 3 (b) is seen, it turns out that the foil 35 on the backside touches a ball 31 and SIMM 37 at this time. The upper foil 33 also touches SIMM. This is the process (h) of drawing 1 , and when combining the foil 35 on the backside with a ball 31 as a part of this down stream processing, it is attained. Foils 33 and 35 are not pasted up on SIMM 37, but it is only in contact with it. Then, after separating a marking-off and an array for the foil of each other next in the location of V typeface notation of drawing 3 (b) on SIMM and demounting SIMM, equipment as shown in drawing 3 (c) and drawing 4 (c) is made. Next, it bevels, as an array as shown in drawing 3 (c) and drawing 4 (b) is shown in drawing 4 (c), and four lugs which are some foils 35 on the backside are made. These lugs are each side of the rectangular head of an array, and are described as A, B, C, and D. Next, as shown in drawing 3 (d) and drawing 4 (d), Lugs B, C, and D are turned up under an array, and as shown in drawing 3 (e) after that, this array is fixed to a next array by ultrasonic association etc. by combining Lug A with one of the lugs B and C of an array, or D after this.
[0025] An interconnect process can be performed as the equipment of a three-dimensional display of drawing 5 shows. With this equipment, one array in which Lug A is carrying out extension is positioned so that this lug A may contact one of the lugs B and C of another array, or D. This procedure is continued at

the path of a straight line or others, and a perfect module is made. The completed module is shown in drawing 6 , it is fixed to Lugs B and C or D of an array 30 which Lug A adjoins, and the path arranged before and after forming the series circuit of 60 arrays is made. Furthermore, the lug used as the input 41 and output 43 to a module is prepared.

[0026] If drawing 2 is explained, and a module will be examined and it will succeed in a trial after forming the module of drawing 6 , a module will progress to the process attached in the charge of supporting material etc., a lug will be ultrasonically combined by joint appearance after that, the encapsulation of the module will be carried out after that, and suitable **** to an environment will be given. Next, the module which carried out encapsulation is examined standardly and it will be in the condition that the module which can operate can be used.

[0027] Although the desirable example of specification [this invention] was explained, to this contractor, I will consider various modification. Therefore, a claim is seen from the conventional technique and should be interpreted as widely as possible so that such all modification may be ****(ed).

[Translation done.]

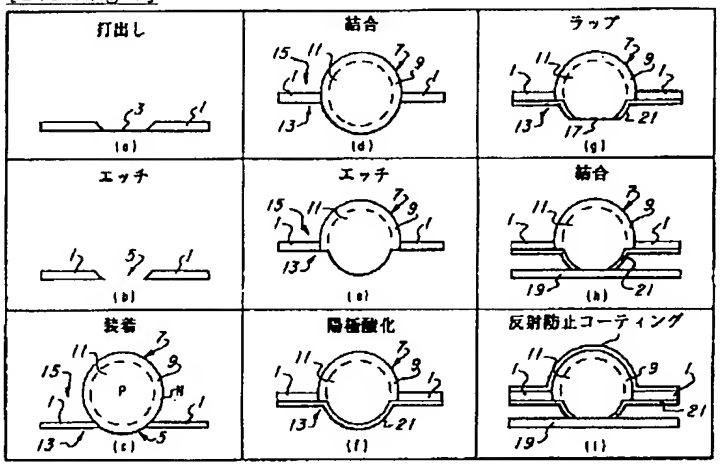
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Schematic drawing showing down stream processing used to form a solar array according to this invention.
[Drawing 2] The process diagram showing the process of drawing 1 .
[Drawing 3] Schematic drawing showing the array interconnect procedure in which it expressed with one dimension.
[Drawing 4] Schematic drawing showing the array interconnect procedure shown by two-dimensional.
[Drawing 5] Schematic drawing showing the array interconnect expressed with the three dimension.
[Drawing 6] Schematic drawing of the module of this invention.
[Description of Notations]
1 1st Aluminium Foil
5 Opening
7 Ball of Silicon
9 N Type Epidermis Section
11 Interior of P Type
19 2nd Aluminium Foil

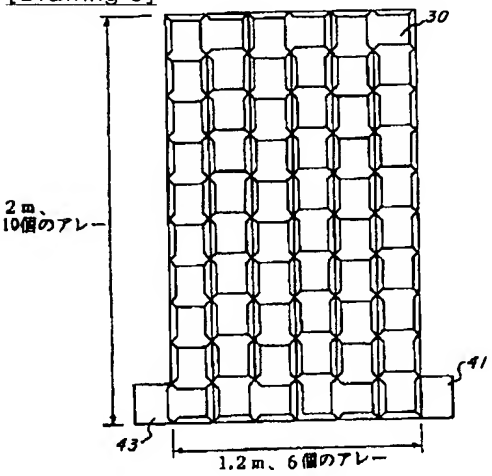
[Translation done.]

DRAWINGS

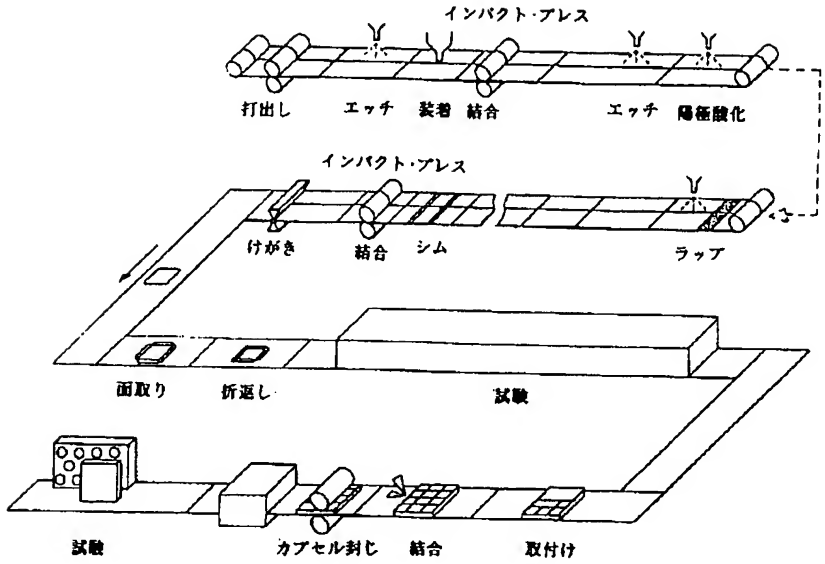
[Drawing 1]



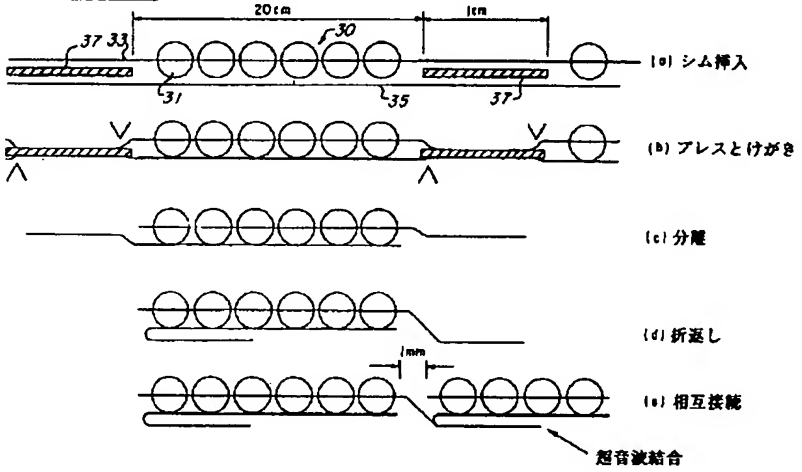
[Drawing 6]



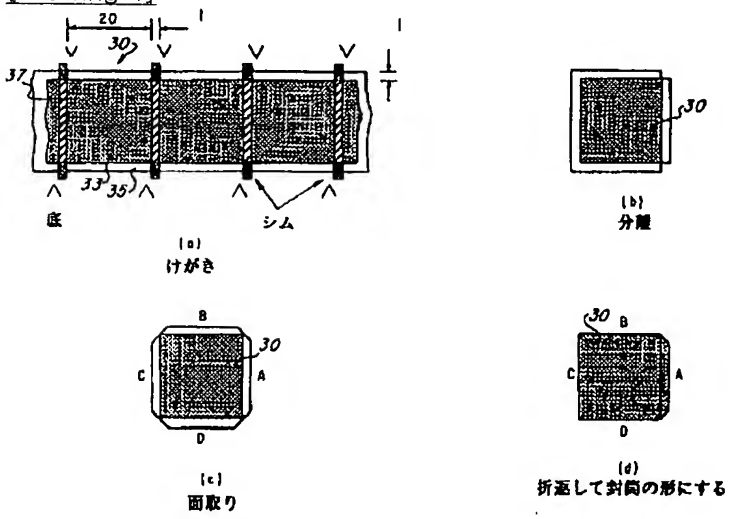
[Drawing 2]



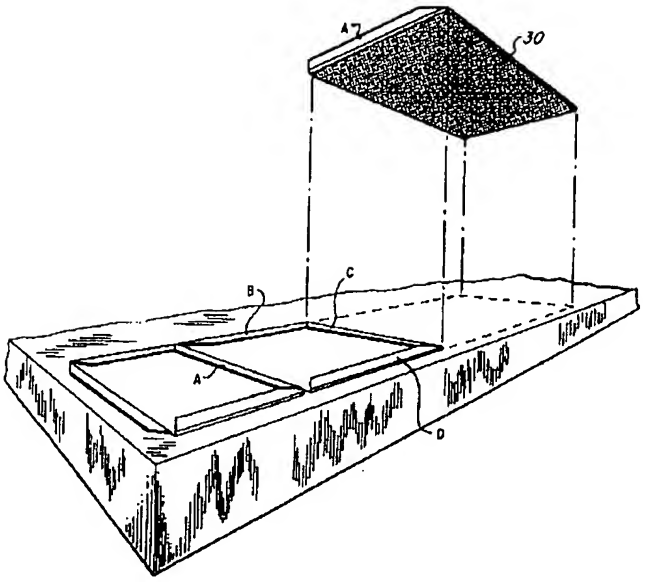
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]